REMARKS

Status of the claims:

With the above amendments, claims 1 and 7 have been amended and claim 6 has been canceled. Thus, claims 1, 3-5, 7, 8, 11, 15, 16, and 19-21 are pending and ready for further action on the merits. No new matter has been added by way of the above amendments. Claim 1 has been amended by incorporating the subject matter of claim 6. Claim 7 has been amended to correct its dependency. Reconsideration is respectfully requested in light of the following remarks.

Rejections under 35 USC §§102/103

Claims 1, 3, 5-8, 11, 16 and 19-21 have been rejected under 35 USC §102(b) as being anticipated by, or alternatively, under 35 USC §103(a) as being unpatentable over Cash '203 (US Patent No. 4,430,203).

Claims 4 and 15 have been rejected under 35 USC §102(b) as being unpatentable over Cash '203 (US Patent No. 4,430,203) in view of Graziani '364 (US Patent No. 4,695,364).

Applicants traverse.

Present Invention

The present invention, as recited in claim 1, relates to a hydrorefining unit for hydrorefining hydrocarbon feed oil including sulfur-containing compounds, comprising:

a first catalyst layer and a second catalyst layer;

a holding member positioned between the first catalyst layer and second catalyst layer for temporarily holding a liquid component that flows out from the first catalyst layer;

a hydrogen feed source;

a hydrogen introduction part, that is connected to the hydrogen feed source and that is arranged downstream of the holding member and upstream of the second catalyst layer, for simultaneously introducing hydrogen from the hydrogen feed source to the liquid component held in the holding member and the second catalyst layer;

a separation space that is positioned at the bottom of the first catalyst layer for separation of vapor component and liquid component;

a gas outlet through which the vapor component is discharged from the separation space; and

means for adjusting pressure of the separation space and/or a space between the holding member and the second catalyst layer

wherein the hydrogen introduced from the hydrogen introduction part has a first hydrogen gas stream and a second hydrogen gas stream, and

with the means for adjusting pressure, with the first hydrogen stream passing through the holding member as a countercurrent to the liquid component that flows out from the first catalyst layer and the second gas stream being introduced to the second catalyst layer as a cocurrent with the liquid component that flows out from the holding member.

Disclosure of Cash '203

Cash '203 discloses a multistage hydrocracking or hydrotreating process wherein a two-phase reaction mixture of a hydrogen rich gas stream and liquid hydrocarbon is passed through a series of spaced catalyst beds and reaction vapors are withdrawn at each interspace between beds and replaced with hydrogen. Such withdrawal and replacement is said to reduce the partial pressure of NH_3 and/or H_2S in the reaction mixture entering the bed succeeding each interspace, thereby increasing the reaction rate between hydrogen and the liquid hydrocarbon.

Disclosure of Graziani '364

Graziani '364 discloses what is said to be an improved multistage hydrodewaxing process for hydrodewaxing a hydrocarbon

feedstock, such as a heavy or light distillate. A two-phase mixture of a hydrogen-rich gas stream and a liquid hydrocarbon is passed through a series of spaced catalyst beds in a single reactor, reaction vapors containing olefins, are withdrawn at each interspace between beds and replaced with hydrogen-rich saturated gas.

Removal of the Rejections over Cash '203 and Graziani '364

Applicants have amended claim 1 to incorporate the features of claim 6 in order to clearly distinguish the invention from Cash '203.

Although Applicants explained the meaning of stripping and the difference between the invention and Cash '203 in the response filed October 31, 2003, Applicants herein more specifically explain what is meant by "stripping", below. The stripping as referred to in the instant invention is to remove or strip impurities such as hydrogen sulfide and ammonia, *etc.* contained in a liquid component by feeding hydrogen gas to the liquid component. In the claimed invention, the liquid component is accumulated in a holding member. See page 3, lines 21-24, page 10, lines 10-14 and 22-24 and page 15, lines 23 to page 16, line 3 of the written description for this disclosure.

In order to perform the stripping, hydrogen gas is introduced to the liquid component held in the holding member such as a valve

tray 35 so that a part of gas or the first hydrogen stream passes through the holding member as a countercurrent to the liquid component. When the part of hydrogen gas passes through the liquid component as countercurrent, the vapor component, such as hydrogen sulfide, contained in the liquid component can be stripped by this stripping. See page 15, line 22 to page 16, line 3. Accordingly, the stripping facilitates the replacement of gas such as hydrogen sulfide and ammonia with fresh hydrogen.

Cash '203 discloses at column 2, lines 38-42:

> *Part of the vapor phase in interface 25 is withdrawn from the upper portion of the interspace via line 28. The portion of vapor withdrawn is replaced with hydrogen introduced into the lower portion of the interspace (i.e., below the vapor withdrawal point) via lines 13 and 29.*

Figure 2 in Cash '203 shows internal devices contained in interspace, which includes a vapor withdrawal device 33, a sieve tray 34 and a hydrogen injection device 35. See column 2, lines 50-56. In addition, Cash '203 discloses "The sieve tray mounted transversely assists in mixing and restricts back flow of cooler, pure gas to the withdrawal device" at column 3, lines 1-7.

From the disclosure of Cash '203, it is noted that the vapor phase generated in the first bed 19 is withdrawn from the vapor withdrawal device 33 having a hollow ring with perforations 37 at the upper portion of the interspace 25 (Figure 1), while the vapor phase not withdrawn and downflowing liquid phase is mixed with

replacement hydrogen injected by a hydrogen injection device 35 at the lower portion of the interspace 25. See also column 2, line 67 to column 3, line 1.

Accordingly, in Cash '203, the replacement hydrogen only stays at the lower portion of the interspace 25, but does not pass through the sieve tray and liquid phase thereon as countercurrent.

The Examiner states in the part of the Office Action entitled "Response to Argument" on page 5 of the Office Action:

> *Cash discloses in column 4, lines 1-12 that up to 100% of the vapors will be withdrawn and replaced by hydrogen. Cash also discloses that replacement hydrogen mixes with the downflowing liquid. Although Cash does not refer to this as stripping, it is certain that at least some components from the liquid are stripped by this hydrogen thereby reducing impurities in the liquid.*

However, neither mixing of the replacement hydrogen with the downflowing liquid nor replacement of the vapor withdrawn with hydrogen mean the "stripping" explained above. The stripping in claim 1 proceeds by the introduction of hydrogen from the hydrogen feed source to the liquid component held in the holding member so that a first hydrogen stream passes thorough the holding member as countercurrent to the liquid component that flows out from the first catalyst layer as defined in amended claim 1. Cash '203 does not disclose this feature. Rather, Cash '203 intends to prevent the replacement hydrogen from passing thorough the holding member as countercurrent as described at page 3, line 1-4 of the instant written description. Cash '203

simply withdraws the vapor by the vapor withdrawal device 33 having a hollow ring with perforations 37, and then mixes the vapor not drawn and liquid phase with replacement hydrogen.

In order to attain the first hydrogen stream passing through the holding member as countercurrent to the liquid component, the unit of the instant invention adjusts pressure of the separation space and/or a space between the holding member and the second catalyst layer by the means for adjusting pressure.

As explained above, the unit of the instant invention defined in claim 1 is different from Cash '203 in effecting the stripping by passing the first hydrogen stream thorough the holding member as countercurrent to the liquid component. With respect to instant claims 11 and 21, Cash '203 does not disclose the stripping of the liquid component with a first hydrogen gas stream or introducing hydrogen from a hydrogen feed source to the liquid component held in the holding member as defined in claims 11 and 21.

Above, Applicants have explained the different features of the instant invention from Cash '203. Applicants also show the advantage or benefit of the unit of the instant invention and process relative to that of Cash '203, below.

The attached Figure A is a schematic diagram of a hydrorefining unit. This unit helps explain the obtained experimental data of hydrorefining. The unit has mainly a first reactor RT01, a second

reactor RT02, a first intermediate high pressure separation vessel VE01 (ventilation vessel) wherein vapor phase is removed, and a high pressure stripping tower TW01 wherein the stripping is performed.

Experiments for hydrorefining gas oil as feed oil have been made with three different unit configurations.

In the first unit configuration, the output line L1 of the first reactor RT01 directly communicates with an input line L2 of the second reactor RT02 by closing a valve V1 between the first reactor RT01 and the first intermediate high pressure separation vessel VE01. Hydrogen is fed into the line L2 from a hydrogen feeding line F02.

In the second unit configuration, the liquid and vapor components eluted out of the first reactor RT01 are fed to the first intermediate high pressure separation vessel VE01 in which the vapor component can be removed, and then passed through the high pressure stripping tower TW01 and lines F04, F05 and L2 into the second reactor RT02. However, in the high pressure stripping tower TW01, the stripping was not performed. No hydrogen was fed from line F05. Rather, hydrogen, which amount corresponds to that removed in the vessel VE01, is fed into the line L2 from the hydrogen line F02. Please note that this configuration corresponds to Cash '203 because any removed hydrogen from the vessel VE01 is replaced by hydrogen provided by line F02.

In the third unit configuration, the liquid and vapor components eluted out of the first reactor RT01 are fed to first intermediate high pressure separation vessel VE01 in which the vapor components are removed. Specifically, H_2S is separated and then passed through high pressure stripping tower TW01. In the high pressure stripping tower, stripping was performed by feeding hydrogen from line F05 into the stripping tower so that the hydrogen passes through the liquid component as a countercurrent. The liquid component eluted from stripping tower TW01 is passed through lines F04, F06 and L2 into the second reactor RT02. The hydrogen fed from line F05 goes out of stripping tower TW01 through a line L3 after the stripping in the stripping tower TW01. Hydrogen, which amount corresponds to that removed in the vessel VE01, is fed into line L2 from hydrogen line F02. Please note that this configuration corresponds to the inventive unit of the instant invention.

Hydrorefining of gas oil at the different reaction temperatures of 300, 320, 340 and 360°C in the first reactor using the three different configurations were performed, respectively. The reaction conditions for the three different configurations are indicated in Table 1A. Moreover, the experimental results are also indicated in Table 1B, Figure B, and Figure C (which shows an enlarged Figure B). As noted from Table 1B and Figures B and C, the sulfur content in the oil refined by the third configuration (*i.e.*, the instant

invention) is substantially lower than that of the second configuration, which corresponds to the method and apparatus of Cash '203, in the temperature range of 320 to 350°C. Thus, the instant invention provides a gas oil that is significantly reduced in sulfur relative to the amount of sulfur that results using the apparatus in Cash '203.

For the above reasons, Applicants submit that the rejections over Cash '203, or Cash '203 in view of Graziani '364 are inapposite. Cash '203 fails to show the "stripping" as disclosed in the instant invention. Moreover, the instant invention is unexpectedly superior to the method disclosed in Cash '203. For these reasons, withdrawal of the rejections is warranted and respectfully requested.

Interview

Applicants' representative would like to thank the Examiner for agreeing to meet with Applicants' representative at 11:00 AM on June 30, 2004.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact T. Benjamin Shroeder (Reg. No. 50,990) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Pursuant to the provisions of 37 C.F.R. §§ 1.17 and 1.136(a), Applicants respectfully petition for a two (2) month extension of time for filing a response in connection with the present application. The required fee of $420.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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2282-0142P

Attachment(s): 1) Figure A
2) Table 1A
3) Table 1B with Figures B and C.

Table 1A

Experiment No.		No H_2S Ventilation Separation Run 1	H_2S Ventilation Separation Run 2	H_2S Ventilation Separation plus Stripper Separation Run 3
Reaction Temperature [1]	[℃]	300,320,340,360	320,330,340,350	320,330,340,350,360
Reaction Pressure [2]	[MPa]	5.0	5.0	5.0
LHSV	[hr^{-1}]	2.0	2.0	2.0
H_2/Oil	[NL/L]	200	200	200
RT-02 H_2 Flow Quantity [3]	[L/hr]	---	80	80
H_2 Flow Quantity Introduced to Stripper [4]	[L/hr]	---	---	80
Temperature of Ventilation Vessel	[℃]	---	Same temperature as that of the reactor	Same temperature as that of the reactor
Temperature of Stripper	[℃]	---	---	Same temperature as that of the reactor
Differential Pressure Between Reaction Towers	[MPa]	---	0.1	0.1

REMARKS:

1) Same reaction temperature was set both for reactors RT01 and RT02.

2) The pressure in the outlet side of reactor RT02 is indicated. In case of Run 1, the pressure in the outlet side of reactor RT01 was not controlled because reactors RT01 and RT02 were connected with each other. In case of Run 2 and Run 3, the pressure in the outlet side of reactor RT01 was controlled to be highter than the pressure in the outlet side of reactor RT02.

3) H_2 was supplemented to reactor RT02 due to the gas removal from vesseal VE01 by the H_2S Ventilation Separation.

4) H_2 was introduced for performing the stripping.

Table 1B

Experiment No.		No H_2S Ventilation Separation Run 1				H_2S Ventilation Separation Run 2				H_2S Ventilation Separation plus Stripper Separation Run 3				
Sample No.		1	2	3	4	1	2	3	4	1	2	3	4	5
Reactor A	[°C]	300	320	340	360	320	330	340	350	320	330	340	350	360
Reactor B	[°C]	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
VE-01	[°C]	—	—	—	—	↑	↑	↑	↑	↑	↑	↑	↑	↑
TW-01	[°C]	—	—	—	—	—	—	—	—	↑	↑	↑	↑	↑
Pressure A	[MPa]	—	—	—	—	5.1	←	←	←	5.1	←	←	←	←
Pressure B	[MPa]	5.0	←	←	←	5.0	←	←	←	5.0	←	←	←	←
LHSV	[hr-1]	2.0	←	←	←	2.0	←	←	←	2.0	←	←	←	←
H_2/Oil		200	←	←	←	200	←	←	←	200	←	←	←	←
Sulfur	[ppm]	3063	1097	215	34	642	247	67	15	317	183	37.3	7.5	2.4
KHDS		8.0663	17.4909	47.0777	126.69	24.7006	43.4832	88.9912	194.737	37.6817	51.4852	121.304	277.876	495.811
LN(KHDS)		2.08769	2.86168	3.8518	4.84174	3.20683	3.77237	4.48854	5.27165	3.62918	3.94129	4.7983	5.62718	6.2062
1/T	[K^{-1}]	0.00174	0.00169	0.00163	0.00158	0.00169	0.00166	0.00163	0.00160	0.00169	0.00166	0.00163	0.00160	0.00158

Fig. B

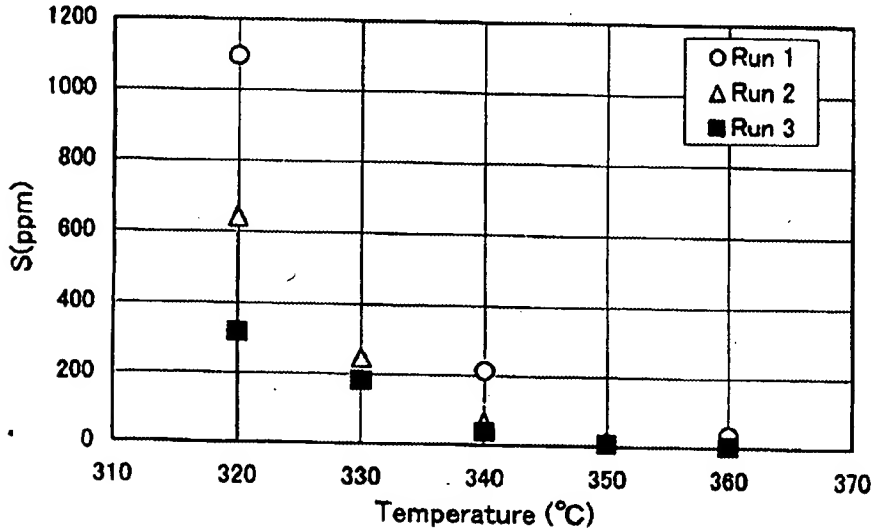

Fig. C

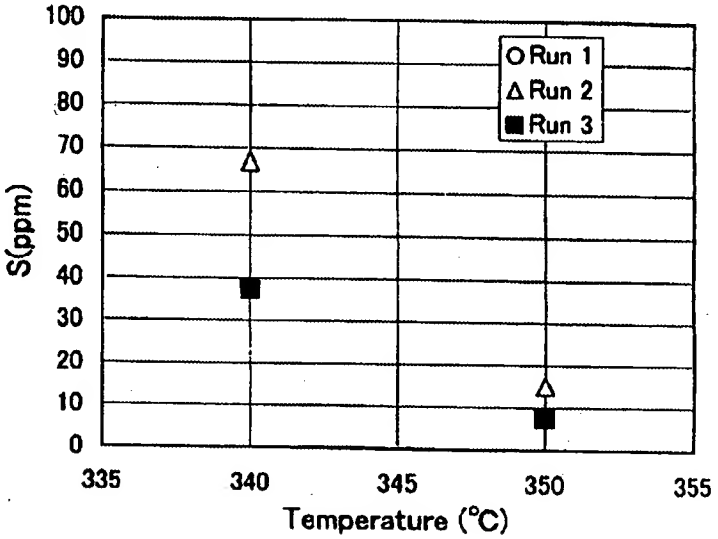

Fig. A